EL857557892US


```
I     {0 {0 {1 {1
       0} 1} 1} 0}
                     Q
      00 01 03 02 (00)
      10 11 13 12 (01)
      30 31 33 32 (11)
      20 21 23 22 (10)
```

Figure 1

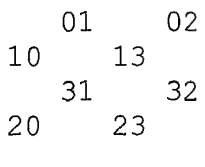

Figure 2

TOETT" 2ET6660

```
remove the most protected bit of I

I-value {}      I    {0}{1}{1}{0}
Q-value ()
                                        Q
                        01     00      (00)
                    10     11          (01)
                        31     30      (11)
                    20     21          (10)
```

Figure 3

```
   01----00
10--|-11  |
 | 31--|-30
20----21
```

Figure 4

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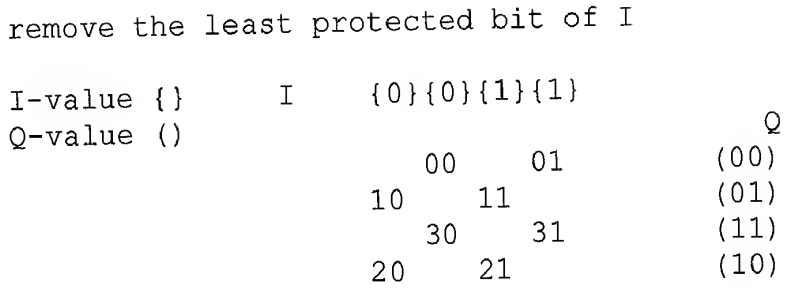

Figure 5

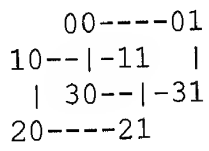

Figure 6

U.S. Express Mail Label No. EL857557892US
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```
remove the most protected bit of Q

I-value {}      I     {0 {1 {1 {0
Q-value ()            0} 0} 1} 1}                  Q

                        02     01            (0)
                   10     13                  (1)
                        12     11            (1)
                   00     03                  (0)
```

Figure 7

```
          02----01
       10--|-13  |
        | 12--|-11
       00----03
```

Figure 8

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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TOETT-2ET6660

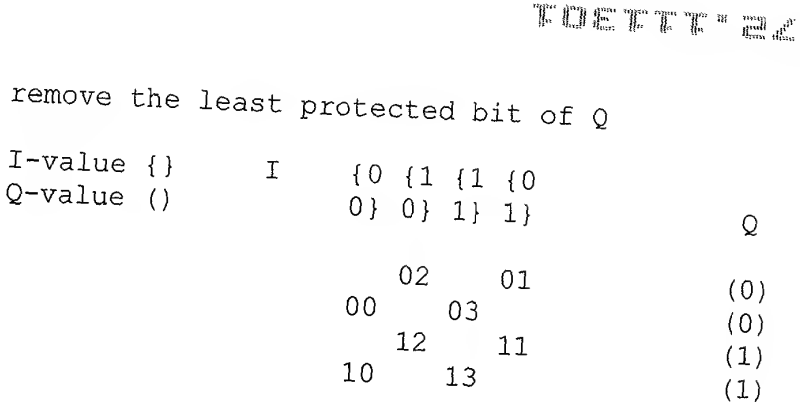

Figure 9

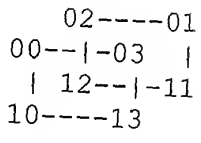

Figure 10.

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional
Constellations With Low Receiver Soft-Decision...
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TOETT" 2ETbbb0

```
0  0  0  0  1  1  1  1
0  0  1  1  1  1  0  0
0  1  1  0  0  1  1  0

00 01 03 02 06 07 05 04 (000)
10 11 13 12 16 17 15 14 (001)
30 31 33 32 36 37 35 34 (011)
20 21 23 22 26 27 25 24 (010)
60 61 63 62 66 67 65 64 (110)
70 71 73 72 76 77 75 74 (111)
50 51 53 52 56 57 55 54 (101)
40 41 43 42 46 47 45 44 (100)
```

Figure 11

```
   01    02    07    04
10    13    16    15
   31    32    37    34
20    23    26    25
   61    62    67    64
70    73    76    75
   51    52    57    54
40    43    46    45
```

Figure 12

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional
Constellations With Low Receiver Soft-Decision...
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remove the most protected bit of I

```
I-value {}      I      {0 {0 {1 {1 {1 {1 {0 {0
Q-value ()             0} 1} 1} 0} 0} 1} 1} 0}     Q

                   01     02     03     00   (000)
               10     13     12     11       (001)
                   31     32     33     30   (011)
               20     23     22     21       (010)
                   61     62     63     60   (110)
               70     73     72     71       (111)
                   51     52     53     50   (101)
               40     43     42     41       (100)
```

Figure 13

```
   01----02----03----00
10--|-13----12----11  |
 | 31    32    33  | 30
20  | 23    22    21  |
 | 61    62    63  | 60
70  | 73    72    71  |
 | 51----52----53--|-50
40----43----42----41
```

Figure 14

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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```
remove the second most protected bit of I

I-value {}      I     {0 {0 {0 {0 {1 {1 {1 {1
Q-value ()            0} 1} 1} 0} 0} 1} 1} 0}        Q

                  01     00     03     02   (000)
               10     11     12     13      (001)
                  31     30     33     32   (011)
               20     21     22     23      (010)
                  61     60     63     62   (110)
               70     71     72     73      (111)
                  51     50     53     52   (101)
               40     41     42     43      (100)
```

Figure 15

```
   01----00----03----02
10--|-11----12----13  |
 | 31    30    33  | 32
20  | 21    22    23  |
 | 61    60    63  | 62
70  | 71    72    73  |
 | 51----50----53--|-52
40----41----42----43
```

Figure 16

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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TOETT*2ET6660

```
remove the least protected bit of I

I-value {}      I     {0 {0 {0 {0 {1 {1 {1 {1
Q-value ()            0} 0} 1} 1} 1} 1} 0} 0}        Q

                   00    01    03    02  (000)
               10    11    13    12      (001)
                   30    31    33    32  (011)
               20    21    23    22      (010)
                   60    61    63    62  (110)
               70    71    73    72      (111)
                   50    51    53    52  (101)
               40    41    43    42      (100)
```

Figure 17

```
   00----01----03----02
10--|-11----13----12  |
 | 30    31    33  | 32
20  | 21    23    22  |
 | 60    61    63  | 62
70  | 71    73    72  |
 | 50----51----53--|-52
40----41----43----42
```

Figure 18

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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TOETT"2ZET6660

```
remove the most protected bit of Q

I-value {}      I      {0 {0 {0 {0 {1 {1 {1 {1
Q-value ()             0  0  1  1  1  1  0  0
                       0} 1} 1} 0} 0} 1} 1} 0}  Q

                   01     02     07     04   (00)
               10     13     16     15       (01)
                   31     32     37     34   (11)
               20     23     26     25       (10)
                   21     22     27     24   (10)
               30     33     36     35       (11)
                   11     12     17     14   (01)
               00     03     06     05       (00)
```

Figure 19

```
   01----02----07----04
10--|-13----16----15  |
 | 31    32    37  | 34
20  | 23    26    25  |
 | 21    22    27  | 24
30  | 33    36    35  |
 | 11----12----17--|-14
00----03----06----05
```

Figure 20

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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```
remove the second most protected bit of Q

I-value {}      I     {0 {0 {0 {0 {1 {1 {1 {1
Q-value ()            0  0  1  1  1  1  0  0
                      0} 1} 1} 0} 0} 1} 1} 0}  Q

                        01    02    07    04  (00)
                    10    13    16    15      (01)
                        11    12    17    14  (01)
                    00    03    06    05      (00)
                        21    22    27    24  (10)
                    30    33    36    35      (11)
                        31    32    37    34  (11)
                    20    23    26    25      (10)
```

Figure 21

```
                        01----02----07----04
                    10--|-13----16----15  |
                     | 11    12    17  | 14
                    00  | 03    06    05  |
                     | 21    22    27  | 24
                    30  | 33    36    35  |
                     | 31----32----37--|-34
                    20----23----26----25
```

Figure 22.

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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TOSTT 2ET6660

```
remove the least protected bit of Q

I-value {}
Q-value ()

I      {0 {0 {0 {0 {1 {1 {1 {1
       0  0  1  1  1  1  0  0
 0} 1} 1} 0} 0} 1} 1} 0}  Q

    01     02     07     04   (00)
00     03     06     05       (00)
    11     12     17     14   (01)
10     13     16     15       (01)
    31     32     37     34   (11)
30     33     36     35       (11)
    21     22     27     24   (10)
20     23     26     25       (10)
```

Figure 23

```
   01----02----07----04
00--|-03----06----05  |
 | 11    12    17  | 14
10  | 13    16    15  |
 | 31    32    37  | 34
30  | 33    36    35  |
 | 21----22----27--|-24
20----23----26----25
```

Figure 24

0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	
0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	
0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	
0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	
00	01	03	02	06	07	05	04	0C	0D	0F	0E	0A	0B	09	08	(0000)
10	11	13	12	16	17	15	14	1C	1D	1F	1E	1A	1B	19	18	(0001)
30	31	33	32	36	37	35	34	3C	3D	3F	3E	3A	3B	39	38	(0011)
20	21	23	22	26	27	25	24	2C	2D	2F	2E	2A	2B	29	28	(0010)
60	61	63	62	66	67	65	64	6C	6D	6F	6E	6A	6B	69	68	(0110)
70	71	73	72	76	77	75	74	7C	7D	7F	7E	7A	7B	79	78	(0111)
50	51	53	52	56	57	55	54	5C	5D	5F	5E	5A	5B	59	58	(0101)
40	41	43	42	46	47	45	44	4C	4D	4F	4E	4A	4B	49	48	(0100)
C0	C1	C3	C2	C6	C7	C5	C4	CC	CD	CF	CE	CA	CB	C9	C8	(1100)
D0	D1	D3	D2	D6	D7	D5	D4	DC	DD	DF	DE	DA	DB	D9	D8	(1101)
F0	F1	F3	F2	F6	F7	F5	F4	FC	FD	FF	FE	FA	FB	F9	F8	(1111)
E0	E1	E3	E2	E6	E7	E5	E4	EC	ED	EF	EE	EA	EB	E9	E8	(1110)
A0	A1	A3	A2	A6	A7	A5	A4	AC	AD	AF	AE	AA	AB	A9	A8	(1010)
B0	B1	B3	B2	B6	B7	B5	B4	BC	BD	BF	BE	BA	BB	B9	B8	(1011)
90	91	93	92	96	97	95	94	9C	9D	9F	9E	9A	9B	99	98	(1001)
80	81	83	82	86	87	85	84	8C	8D	8F	8E	8A	8B	89	88	(1000)

Figure 25

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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TOETT" 2ET6660

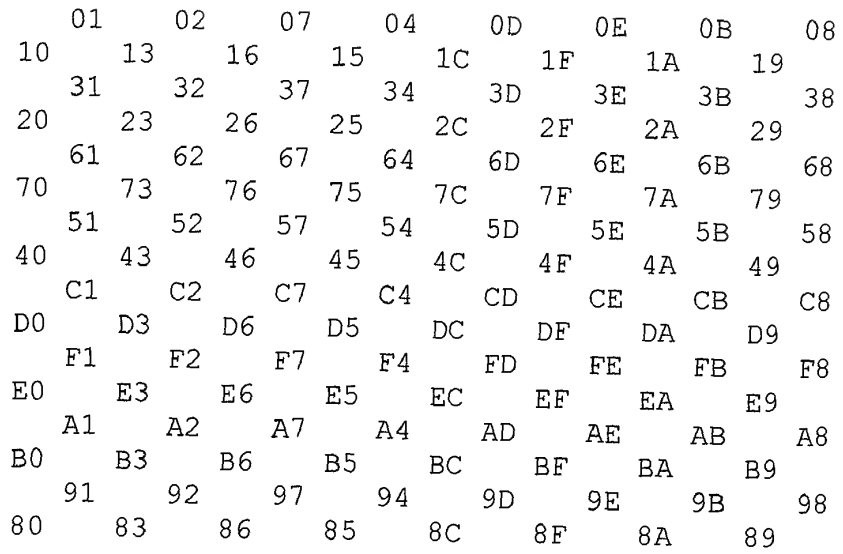

Figure 26

remove the most protected bit of I

I-value {}I	{0 0}	{0 1}	{0 1}	{0 0}	{1 0}	{1 1}	{1 1}	{1 0}	{1 0}	{1 1}	{1 1}	{1 0}	{0 0}	{0 1}	{0 1}	{0 0}	
Q-value ()	0	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	Q
		01		02		07		04		05		06		03		00	(0000)
	10		13		16		15		14		17		12		11		(0001)
		31		32		37		34		35		36		33		30	(0011)
	20		23		26		25		24		27		22		21		(0010)
		61		62		67		64		65		66		63		60	(0110)
	70		73		76		75		74		77		72		71		(0111)
		51		52		57		54		55		56		53		50	(0101)
	40		43		46		45		44		47		42		41		(0100)
		C1		C2		C7		C4		C5		C6		C3		C0	(1100)
	D0		D3		D6		D5		D4		D7		D2		D1		(1101)
		F1		F2		F7		F4		F5		F6		F3		F0	(1111)
	E0		E3		E6		E5		E4		E7		E2		E1		(1110)
		A1		A2		A7		A4		A5		A6		A3		A0	(1010)
	B0		B3		B6		B5		B4		B7		B2		B1		(1011)
		91		92		97		94		95		96		93		90	(1001)
	80		83		86		85		84		87		82		81		(1000)

Figure 27

U.S. Express Mail Label No. EL857557892US
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TOETTT"2ZETGGGO

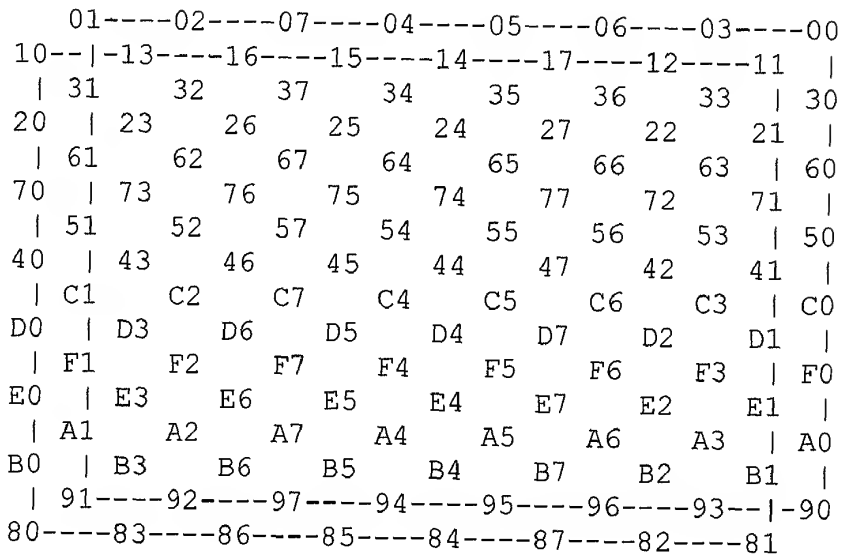

Figure 28

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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remove the second most protected bit of I

```
I-value {}I     {0 {0 {0 {0 {0 {0 {0 {0 {1 {1 {1 {1 {1 {1 {1 {1
Q-value ()       0  0  1  1  1  1  0  0  0  0  1  1  1  1  0  0
                0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0}                Q

    01    02    03    00    05    06    07    04    (0000)
10    13    12    11    14    17    16    15        (0001)
    31    32    33    30    35    36    37    34    (0011)
20    23    22    21    24    27    26    25        (0010)
    61    62    63    60    65    66    67    64    (0110)
70    73    72    71    74    77    76    75        (0111)
    51    52    53    50    55    56    57    54    (0101)
40    43    42    41    44    47    46    45        (0100)
    C1    C2    C3    C0    C5    C6    C7    C4    (1100)
D0    D3    D2    D1    D4    D7    D6    D5        (1101)
    F1    F2    F3    F0    F5    F6    F7    F4    (1111)
E0    E3    E2    E1    E4    E7    E6    E5        (1110)
    A1    A2    A3    A0    A5    A6    A7    A4    (1010)
B0    B3    B2    B1    B4    B7    B6    B5        (1011)
    91    92    93    90    95    96    97    94    (1001)
80    83    82    81    84    87    86    85        (1000)
```

Figure 29

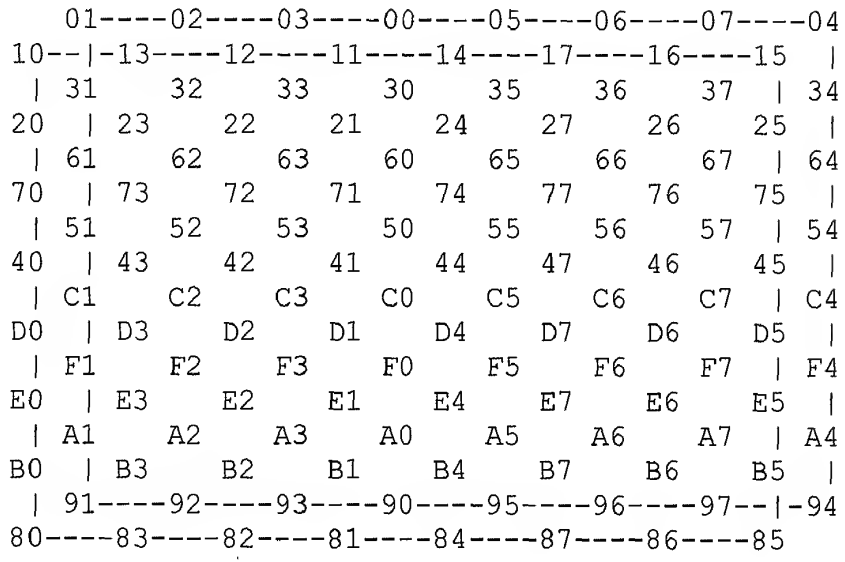

Figure 30

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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remove the third most protected bit of I

```
I-value {}I     {0 {0 {0 {0 {0 {0 {0 {0 {1 {1 {1 {1 {1 {1 {1 {1
Q-value ()       0  0  0  0  1  1  1  1  1  1  1  1  0  0  0  0          Q
                0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0}

          01    00    03    02    07    06    05    04    (0000)
      10    11    12    13    16    17    14    15        (0001)
          31    30    33    32    37    36    35    34    (0011)
      20    21    22    23    26    27    24    25        (0010)
          61    60    63    62    67    66    65    64    (0110)
      70    71    72    73    76    77    74    75        (0111)
          51    50    53    52    57    56    55    54    (0101)
      40    41    42    43    46    47    44    45        (0100)
          C1    C0    C3    C2    C7    C6    C5    C4    (1100)
      D0    D1    D2    D3    D6    D7    D4    D5        (1101)
          F1    F0    F3    F2    F7    F6    F5    F4    (1111)
      E0    E1    E2    E3    E6    E7    E4    E5        (1110)
          A1    A0    A3    A2    A7    A6    A5    A4    (1010)
      B0    B1    B2    B3    B6    B7    B4    B5        (1011)
          91    90    93    92    97    96    95    94    (1001)
      80    81    82    83    86    87    84    85        (1000)
```

Figure 31

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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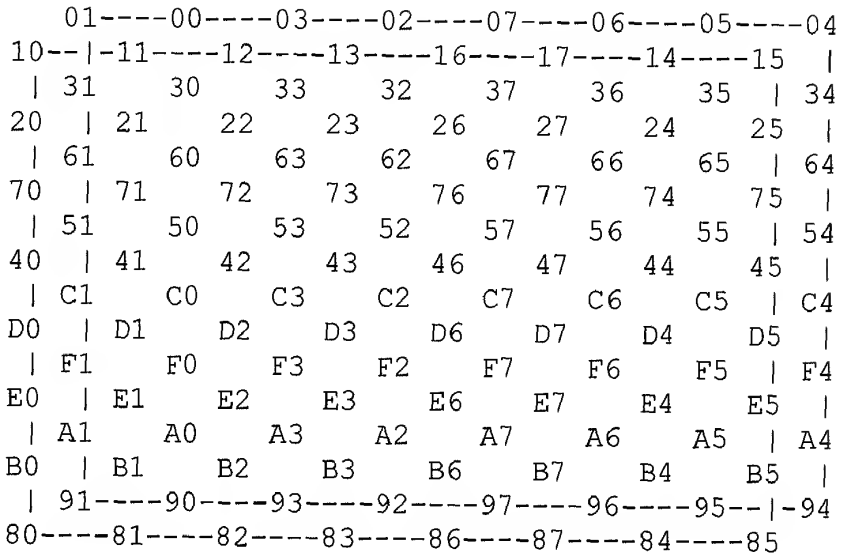

Figure 32

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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TOETT*2ET6660

remove the least protected bit of I

```
I-value {}I     {0 {0 {0 {0 {0 {0 {0 {0 {1 {1 {1 {1 {1 {1 {1 {1
Q-value ()       0  0  0  0  1  1  1  1  1  1  1  1  0  0  0  0          Q
                0} 0} 1} 1} 1} 1} 0} 0} 0} 0} 1} 1} 1} 1} 0} 0}

    00    01    03    02    06    07    05    04   (0000)
10    11    13    12    16    17    15    14       (0001)
    30    31    33    32    36    37    35    34   (0011)
20    21    23    22    26    27    25    24       (0010)
    60    61    63    62    66    67    65    64   (0110)
70    71    73    72    76    77    75    74       (0111)
    50    51    53    52    56    57    55    54   (0101)
40    41    43    42    46    47    45    44       (0100)
    C0    C1    C3    C2    C6    C7    C5    C4   (1100)
D0    D1    D3    D2    D6    D7    D5    D4       (1101)
    F0    F1    F3    F2    F6    F7    F5    F4   (1111)
E0    E1    E3    E2    E6    E7    E5    E4       (1110)
    A0    A1    A3    A2    A6    A7    A5    A4   (1010)
B0    B1    B3    B2    B6    B7    B5    B4       (1011)
    90    91    93    92    96    97    95    94   (1001)
80    81    83    82    86    87    85    84       (1000)
```

Figure 33

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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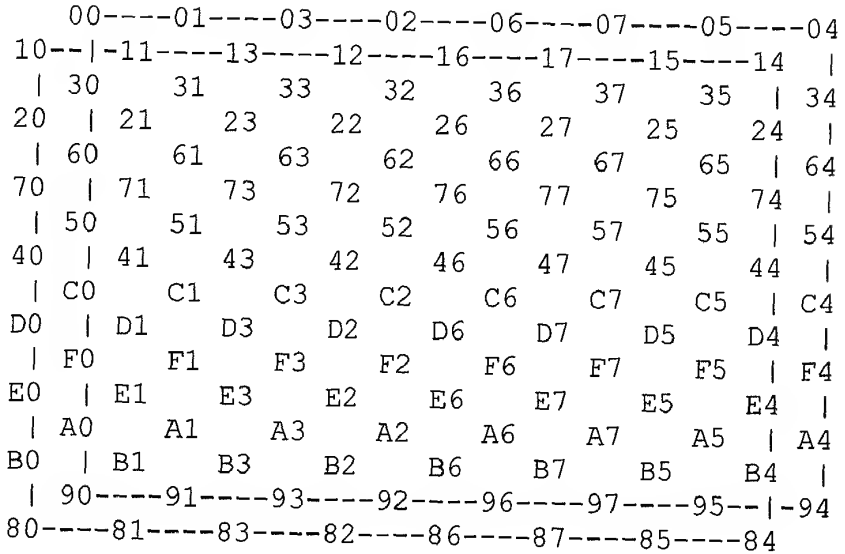

Figure 34

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
Attorney: Ronald Coslick – 042159-0201
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remove the most protected bit of Q

```
I-value {}I     {0 {0 {0 {0 {0 {0 {0 {0 {1 {1 {1 {1 {1 {1 {1 {1
Q-value ()       0  0  0  0  1  1  1  1  1  1  1  1  0  0  0  0
                 0  0  1  1  1  1  0  0  0  0  1  1  1  1  0  0          Q
                0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0}

   01    02    07    04    0D    0E    0B    08   (000)
10    13    16    15    1C    1F    1A    19     (001)
   31    32    37    34    3D    3E    3B    38   (011)
20    23    26    25    2C    2F    2A    29     (010)
   61    62    67    64    6D    6E    6B    68   (110)
70    73    76    75    7C    7F    7A    79     (111)
   51    52    57    54    5D    5E    5B    58   (101)
40    43    46    45    4C    4F    4A    49     (100)
   41    42    47    44    4D    4E    4B    48   (100)
50    53    56    55    5C    5F    5A    59     (101)
   71    72    77    74    7D    7E    7B    78   (111)
60    63    66    65    6C    6F    6A    69     (110)
   21    22    27    24    2D    2E    2B    28   (010)
30    33    36    35    3C    3F    3A    39     (011)
   11    12    17    14    1D    1E    1B    18   (001)
00    03    06    05    0C    0F    0A    09     (000)
```

Figure 35

EL857557892US

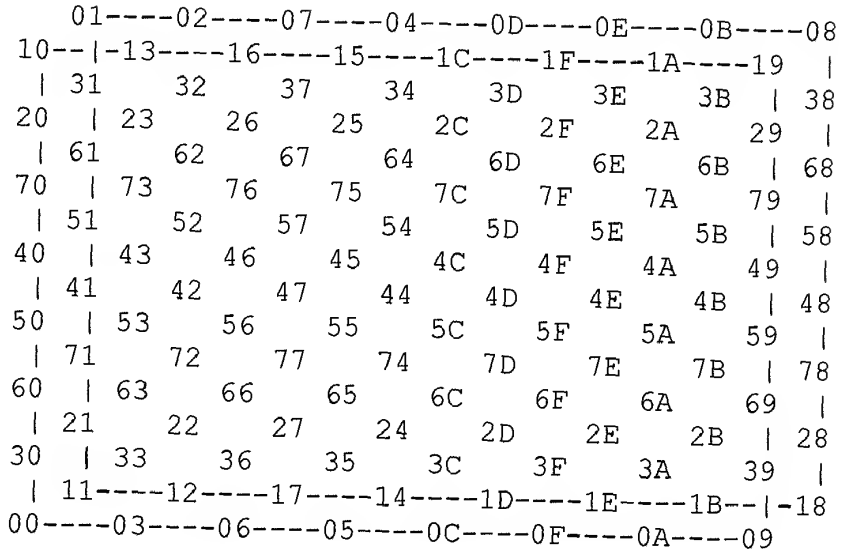

Figure 36

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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remove the second most protected bit of Q

```
I-value {}I     {0 {0 {0 {0 {0 {0 {0 {0 {1 {1 {1 {1 {1 {1 {1 {1
Q-value ()       0  0  0  0  1  1  1  1  1  1  1  1  0  0  0  0
                 0  0  1  1  1  1  0  0  0  0  1  1  1  1  0  0
                0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0}        Q

    01     02     07     04     0D     0E     0B     08    (000)
10     13     16     15     1C     1F     1A     19        (001)
    31     32     37     34     3D     3E     3B     38    (011)
20     23     26     25     2C     2F     2A     29        (010)
    21     22     27     24     2D     2E     2B     28    (010)
30     33     36     35     3C     3F     3A     39        (011)
    11     12     17     14     1D     1E     1B     18    (001)
00     03     06     05     0C     0F     0A     09        (000)
    41     42     47     44     4D     4E     4B     48    (100)
50     53     56     55     5C     5F     5A     59        (101)
    71     72     77     74     7D     7E     7B     78    (111)
60     63     66     65     6C     6F     6A     69        (110)
    61     62     67     64     6D     6E     6B     68    (110)
70     73     76     75     7C     7F     7A     79        (111)
    51     52     57     54     5D     5E     5B     58    (101)
40     43     46     45     4C     4F     4A     49        (100)
```

Figure 37

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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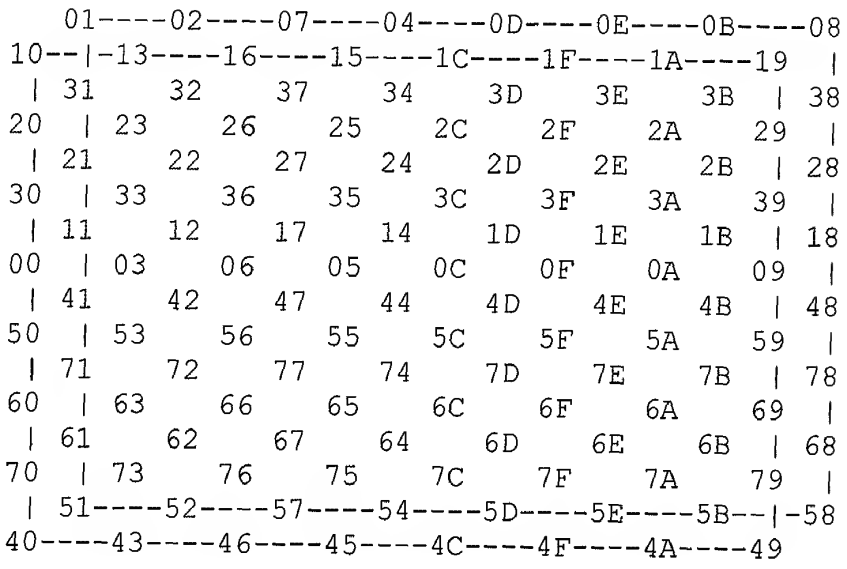

Figure 38

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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remove the third most protected bit of Q

```
I-value {}I      {0 {0 {0 {0 {0 {0 {0 {0 {1 {1 {1 {1 {1 {1 {1 {1
Q-value ()        0  0  0  0  1  1  1  1  1  1  1  1  0  0  0  0
                  0  0  1  1  1  1  0  0  0  0  1  1  1  1  0  0          Q
                 0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0}

    01    02    07    04    0D    0E    0B    08    (000)
10    13    16    15    1C    1F    1A    19        (001)
    11    12    17    14    1D    1E    1B    18    (001)
00    03    06    05    0C    0F    0A    09        (000)
    21    22    27    24    2D    2E    2B    28    (010)
30    33    36    35    3C    3F    3A    39        (011)
    31    32    37    34    3D    3E    3B    38    (011)
20    23    26    25    2C    2F    2A    29        (010)
    61    62    67    64    6D    6E    6B    68    (110)
70    73    76    75    7C    7F    7A    79        (111)
    71    72    77    74    7D    7E    7B    78    (111)
60    63    66    65    6C    6F    6A    69        (110)
    41    42    47    44    4D    4E    4B    48    (100)
50    53    56    55    5C    5F    5A    59        (101)
    51    52    57    54    5D    5E    5B    58    (101)
40    43    46    45    4C    4F    4A    49        (100)
```

Figure 39

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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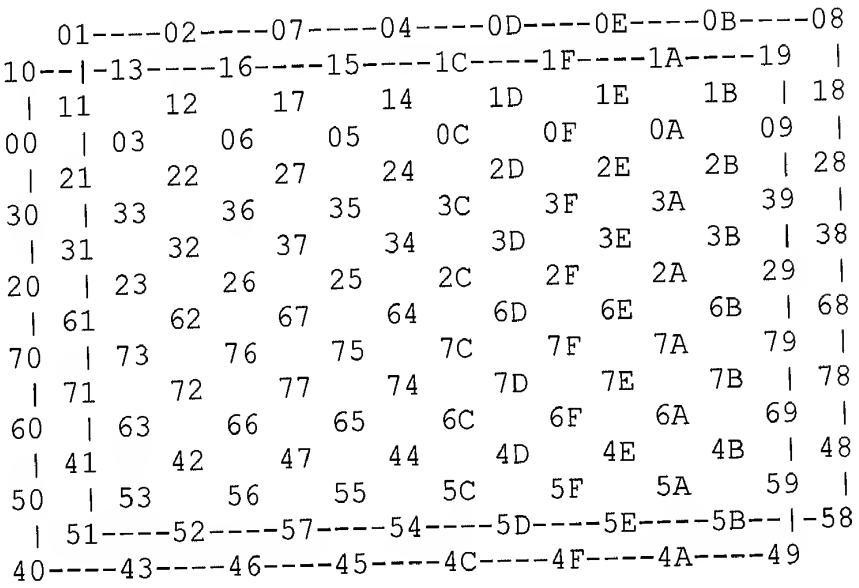

Figure 40

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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remove the least protected bit of Q

```
I-value {}I     {0 {0 {0 {0 {0 {0 {0 {0 {1 {1 {1 {1 {1 {1 {1 {1
Q-value ()       0  0  0  0  1  1  1  1  1  1  1  1  0  0  0  0
                 0  0  1  1  1  1  0  0  0  0  1  1  1  1  0  0          Q
                0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0} 0} 1} 1} 0}

   01    02    07    04    0D    0E    0B    08   (000)
00    03    06    05    0C    0F    0A    09     (000)
   11    12    17    14    1D    1E    1B    18   (001)
10    13    16    15    1C    1F    1A    19     (001)
   31    32    37    34    3D    3E    3B    38   (011)
30    33    36    35    3C    3F    3A    39     (011)
   21    22    27    24    2D    2E    2B    28   (010)
20    23    26    25    2C    2F    2A    29     (010)
   61    62    67    64    6D    6E    6B    68   (110)
60    63    66    65    6C    6F    6A    69     (110)
   71    72    77    74    7D    7E    7B    78   (111)
70    73    76    75    7C    7F    7A    79     (111)
   51    52    57    54    5D    5E    5B    58   (101)
50    53    56    55    5C    5F    5A    59     (101)
   41    42    47    44    4D    4E    4B    48   (100)
40    43    46    45    4C    4F    4A    49     (100)
```

Figure 41

U.S. Express Mail Label No. EL857557892US
System and Method Using Multi-Dimensional Constellations With Low Receiver Soft-Decision...
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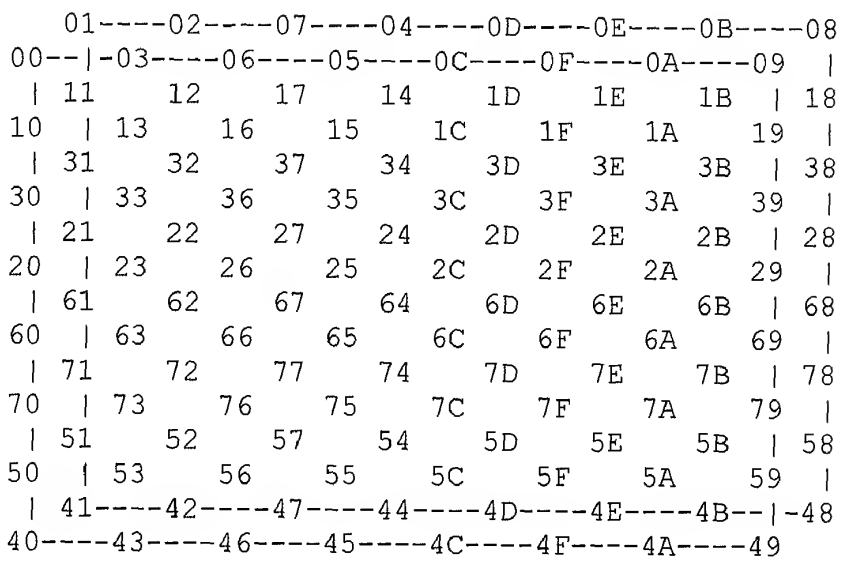


Figure 42

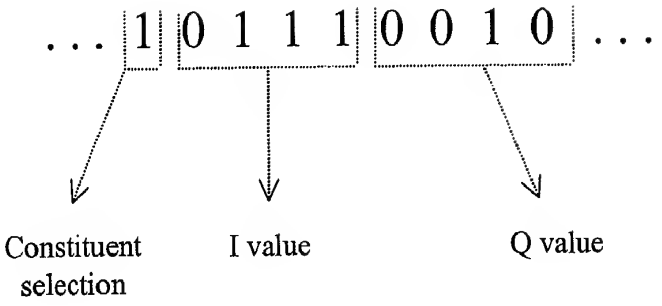
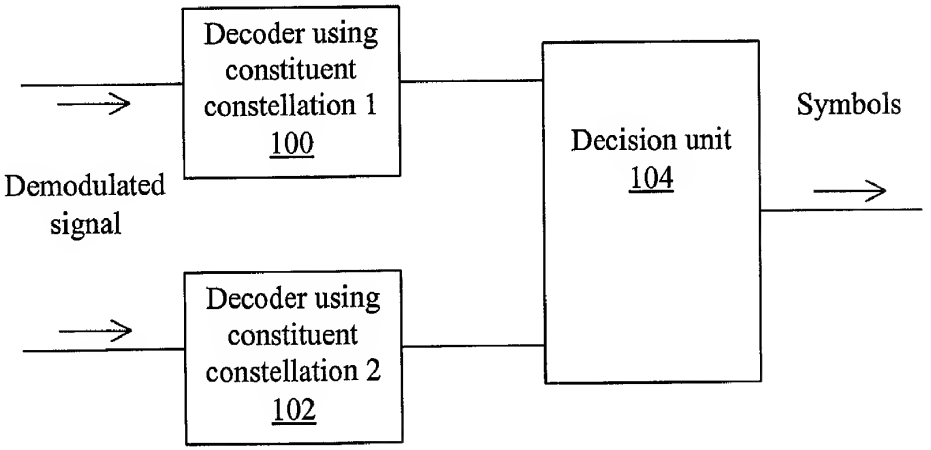


Figure 43

Figure 44



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